## What is claimed is:

- 1. A method of evaluating whiteness of light emitted from
- 2 a light source, comprising the steps of:
- 3 calculating chroma C, using a method defined by the
- 4 CIE 1997 Interim Color Appearance Model (Simple Version);
- 5 and
- 6 calculating whiteness W from the chroma C using an
- 7 equation (1),
- $W = aC + b \cdot \cdot \cdot (1)$
- 9 where the coefficient a is a negative real number
- 10 and the coefficient b is a positive real number.
- 1 2. The method of Claim 1,
  - 2 wherein the whiteness W is 100 when the chroma C is 0.
  - 1 3. The method of Claim 2,
  - wherein the whiteness W is 50 under a standard
  - 3 illuminant A.
  - 1 4. The method of Claim 1,
  - wherein the chroma C is a chroma of the light emitted
  - 3 from the light source, and
  - 4 the coefficient a is -5.3 and the coefficient b is 100.
  - 5. The method of Claim 1,

- wherein the chroma C is a chroma of light obtained
- 3 when the light from the light source is reflected off from
- 4 a surface of an object whose Munsell value and Munsell chroma
- 5 is 9.5 and 0, respectively, and
- the coefficient a is -4.4 and the coefficient b is 100.
- 1 6. The method of Claim 1,
- 2 wherein the chroma is a chroma of light obtained when
- 3 the light emitted from the light source is reflected off
- 4 a blank surface of a newspaper, and
- 5 the coefficient a is -3.3 and the coefficient b is 100.
- 7. A method of evaluating comparative whiteness
- 2 of light emitted from two light sources, comprising the
- 3 steps of:
- 4 calculating chroma C1 of light from a first
- 5 light source and chroma C2 of light from a second light
- 6 source using a method defined by the CIE 1997 Interim
- 7 Color Appearance Model (Simple Version); and
- 8 calculating comparative whiteness Wc from the chroma Cl
- 9 and the chroma C2, using an equation (2),
- $Wc = (C1 C2) / C1 \cdot \cdot \cdot (2).$ 
  - 8. A light source, being characterized by:
- 2 emitting light whose whiteness is no smaller

- 3 than 85 and whose visual clarity index is no smaller than 110,
- 4 the whiteness W being calculated using chroma C of the light
- 5 and an equation (3),
- $W = -5.3C + 100 \cdot \cdot \cdot (3)$
- 7 wherein the chroma C is calculated using a method
- 8 defined by the CIE 1997 Interim Color Appearance Model (Simple
- 9 Version)
- 1 9. The light source of Claim 8,
- 2 wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light
- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- 6 wherein a ratio of a radiant energy Qv to a radiant
- 7 energy Qg satisfies an inequality (4) for a correlated color
- 8 temperature T[K]
- 9  $Qq/Qv \ge -0.11 \times 10^4 / T + 0.30 \cdot \cdot \cdot (4)$
- wherein the radiant energy Qv is in a wavelength of
- 380nm to 780nm and radiant energy Qg in a wavelength
- 12 of 505nm to 530nm.
  - 1 10. The light source of Claim 9,
- wherein the phosphor layer contains, as major components:
- a phosphor containing bivalent Europium as an

- 4 emission center and having a peak emission at a wavelength range
- 5 of 440nm to 470nm;
- a phosphor containing bivalent manganese as an emission
- 7 center and having a peak emission at a wavelength range of 505nm
- 8 to 530nm;
- 9 a phosphor containing trivalent terbium as an emission
- 10 center and having a peak emission at a wavelength range of 540nm
- 11 to 570nm; and
- 12 a phosphor containing trivalent europium as an emission
- 13 center and having a peak emission at a wavelength range of 600nm
- 14 to 620nm.
  - 1 11. The light source of Claim 10,
- wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength
- 4 range of 440nm to 470nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}: Eu^{2+};$
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>:  $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)  $_{6}Cl_{2}:Eu^{2+}$
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained in
- 10 the phosphors.
  - 1 12. The light source of Claim 10,
  - 2 wherein the phosphor containing the bivalent manganese

- 3 as an emission center and having a peak emission at a wavelength
- 4 range of 505nm to 530nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}: Eu^{2+}, Mn^{2+};$
- 6  $CeMgAl_{11}O_{19}:Mn^{2+};$
- 7 Ce (Mg, Zn)  $Al_{11}O_{19}:Mn^{2+}$ ;
- 8  $Zn_2SiO_4:Mn^{2+}$ ; and
- 9  $CeMgAl_{11}O_{19}:Tb^{3+},Mn^{2+}$
- wherein compounds on the left side denote host crystals,
- 11 and ions on the right side are emission centers contained in
- 12 the phosphors.
- 1 13. The light source of Claim 10,
- wherein the phosphor containing the trivalent terbium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 540nm to 570nm is composed of at least one of:
- 5  $LaPO_4:Ce^{3+},Tb^{3+}$ ; and
- 6  $CeMgAl_{11}O_{19}: Tb^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 14. The light source of Claim 10,
- wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:

- 5  $Y_2O_3: Eu^{3+}$ ; and
- 6 Gd<sub>2</sub>O<sub>3</sub>: Eu<sup>3+</sup>
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 15. The light source of Claim 9,
- wherein the phosphor layer has, as major components:
- a phosphor containing both bivalent europium and bivalent
- 4 manganese as emission centers and having emission peaks both
- 5 at a wavelength range of 440nm to 470nm and at 505nm to 530nm;
- a phosphor containing trivalent terbium as an emission
- 7 center and having an emission peak at a wavelength range of 540nm
- 8 to 570nm; and
- a phosphor containing trivalent europium as an emission
- 10 center and having an emission peak at a wavelength range of 600nm
- 11 to 620nm.
- 1 16. The light source of Claim 15,
- 2 wherein the phosphor containing the bivalent europium and
- 3 bivalent manganese as emission centers and having emission peaks
- 4 both at a wavelength range of 440nm to 470nm and at 505nm to
- 5 530nm is
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>: Eu<sup>2+</sup>, Mn<sup>2+</sup>
- 7 wherein a compound on the left side denotes a host crystal,

- 8 and ions on the right side are emission centers contained in
- 9 the phosphor.
- 1 17. The light source of Claim 15,
- wherein the phosphor containing the trivalent terbium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 540nm to 570nm is composed of at least one of:
- 5  $LaPO_4:Ce^{3+},Tb^{3+}$ ; and
- 6  $CeMgAl_{11}O_{19}:Tb^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 18. The light source of Claim 15,
- 2 wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3:Eu^{3+}$ ; and
- 6  $Gd_2O_3: Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 19. The light source of Claim 9,
- wherein the phosphor layer contains, as major

- 3 components:
- a phosphor containing bivalent europium as an emission
- 5 center and having an emission peak at 440nm to 470nm;
- 6 a phosphor containing both trivalent terbium and bivalent
- 7 manganese as emission centers and having emission peaks both
- 8 at a wavelength range of 505nm to 530nm and at 540nm to 570nm;
- 9 and
- 10 a phosphor containing trivalent europium as an emission
- 11 center and having an emission peak at 600nm.
- 1 20. The light source of Claim 19,
- wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength
- 4 range of 440nm to 470nm is composed of at least one of:
- 5 BaMgAl<sub>10</sub>O<sub>17</sub>:Eu<sup>2+</sup>;
- 6  $BaMgAl_{10}O_{17}:Eu^{2+}, Mn^{2+}; and$
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub>:Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained in
- 10 the phosphors.
- 1 21. The light source of Claim 19,
- wherein the phosphor containing the trivalent terbium
- 3 and the bivalent manganese as emission centers and having peak
- 4 emissions both at a wavelength range of 505nm to 530nm and at

- 5 540nm to 570nm is
- 6  $CeMgAl_{11}O_{19}: Tb^{3+}, Mn^{2+}$
- 7 wherein a compound on the left side denotes a host crystal,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphor.
- 1 22. The light source of Claim 19,
- wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3: Eu^{3+}$ ; and
- 6  $Gd_2O_3:Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 23. A light source, being characterized by:
- 2 emitting light whose whiteness W is no smaller than 85,
- 3 and whose visual clarity index is no smaller than 115, the
- 4 whiteness W being calculated using chroma C of the light and
- 5 an equation(5)
- $W = -5.3C + 100 \cdot \cdot \cdot (5)$
- 7 wherein the chroma C is calculated using a method defined
- 8 by the CIE 1997 Interim Color Appearance Model (Simple Version).

- 1 24. The light source of Claim 23,
- wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light
- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- wherein a ratio of a radiant energy Qv to a radiant
- 7 energy Qg satisfies an inequality (6) for a correlated color
- 8 temperature T[K]
- 9  $Qg/Qv \ge -0.11 \times 10^4/T + 0.30 \cdot \cdot \cdot (6)$
- wherein the radiant energy Qv is in a wavelength of
- 11 380nm to 780nm and radiant energy Qg in a wavelength
- 12 of 505nm to 530nm.
  - 1 25. The light source of Claim 24,
  - 2 wherein the phosphor layer contains, as major components:
  - a phosphor containing bivalent Europium as an
  - 4 emission center and having a peak emission at a wavelength range
  - 5 of 440nm to 470nm;
  - 6 a phosphor containing bivalent manganese as an emission
  - 7 center and having a peak emission at a wavelength range of 505nm
- 8 to 530nm;
- 9 a phosphor containing trivalent terbium as an emission
- 10 center and having a peak emission at a wavelength range of 540nm
- 11 to 570nm; and
- a phosphor containing trivalent europium as an emission

- 1 center and having a peak emission at a wavelength range of 600nm
- 2 to 620nm.
- 1 26. The light source of Claim 25,
- wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength
- 4 range of 440nm to 470nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}:Eu^{2+};$
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>:  $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub>:Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained
- 10 in the phosphors.
  - 1 27. The light source of Claim 25,
  - wherein the phosphor containing the bivalent manganese
  - 3 as an emission center and having a peak emission at a wavelength
  - 4 range of 505nm to 530nm is composed of at least one of:
  - 5  $BaMgAl_{10}O_{17}: Eu^{2+}, Mn^{2+};$
- 6  $CeMgAl_{11}O_{19}:Mn^{2+};$
- 7 Ce (Mg, Zn)  $Al_{11}O_{19}:Mn^{2+}$ ;
- $Zn_2SiO_4:Mn^{2+}$ ; and
- 9  $CeMgAl_{11}O_{19}: Tb^{3+}, Mn^{2+}$
- wherein compounds on the left side denote host crystals,
- 11 and ions on the right side are emission centers contained

- 12 in the phosphors.
  - 1 28. The light source of Claim 25,
  - wherein the phosphor containing the trivalent terbium
  - 3 as an emission center and having an emission peak at a wavelength
  - 4 range of 540nm to 570nm is composed of at least one of:
  - 5 LaPO<sub>4</sub>:  $Ce^{3+}$ ,  $Tb^{3+}$ ; and
  - 6  $CeMgAl_{11}O_{19}:Tb^{3+}$
  - 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 29. The light source of Claim 25,
- 2 wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3: Eu^{3+}$ ; and
- 6  $Gd_2O_3:Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 30. The light source of Claim 24,
- wherein the phosphor layer has, as major components:
- a phosphor containing both bivalent europium and bivalent

- 4 manganese as emission centers and having emission peaks both
- 5 at a wavelength range of 440nm to 470nm and at 505nm to 530nm;
- a phosphor containing trivalent terbium as an emission
- 7 center and having an emission peak at a wavelength range of 540nm
- 8 to 570nm; and
- a phosphor containing trivalent europium as an emission
- 10 center and having an emission peak at a wavelength range of 600nm
- 11 to 620nm.
- 1 31. The light source of Claim 30,
- wherein the phosphor containing the bivalent europium and
- 3 bivalent manganese as emission centers and having emission peaks
- 4 both at a wavelength range of 440nm to 470nm and at 505nm to
- 5 530nm is
- 6  $BaMgAl_{10}O_{17}: Eu^{2+}, Mn^{2+}$
- 7 wherein a compound on the left side denotes a host crystal,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphor.
- 1 32. The light source of Claim 30,
- wherein the phosphor containing the trivalent terbium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 540nm to 570nm is composed of at least one of:
- 5  $LaPO_4:Ce^{3+}$ ,  $Tb^{3+}$ ; and
- 6  $CeMgAl_{11}O_{19}: Tb^{3+}$

- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 33. The light source of Claim 30,
- wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3: Eu^{3+}$ ; and
- 6  $Gd_2O_3:Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 34. The light source of Claim 24,
- wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength
- 4 range of 440nm to 470nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}:Eu^{2+};$
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>: $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)  $_{6}Cl_{2}$ : Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained in
- 10 the phosphors.

- 1 35. The light source of Claim 34,
- wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength
- 4 range of 440nm to 470nm is composed of at least one of:
- 5 BaMgAl<sub>10</sub>O<sub>17</sub>: Eu<sup>2+</sup>;
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>:  $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub>:Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained in
- 10 the phosphors.
  - 1 36. The light source of Claim 34,
  - wherein the phosphor containing the trivalent terbium
  - 3 and the bivalent manganese as emission centers and having peak
  - 4 emissions both at a wavelength range of 505nm to 530nm and at
  - 5 540nm to 570nm is
  - 6  $CeMgAl_{11}O_{19}: Tb^{3+}, Mn^{2+}$
  - 7 wherein a compound on the left side denotes a host crystal,
  - 8 and ions on the right side are emission centers contained
  - 9 in the phosphor.
- 1 37. The light source of Claim 34,
- 2 wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:

- 5  $Y_2O_3:Eu^{3+}$ ; and
- 6 Gd<sub>2</sub>O<sub>3</sub>: Eu<sup>3+</sup>
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 38. A light source, being characterized by:
- 2 emitting light whose whiteness is no smaller than 65
- 3 obtained when the light is reflected from a blank surface of
- 4 a newspaper, the whiteness being calculated using chroma C of
- 5 the light and an equation (7),
- $W = -3.3C + 100 \cdot \cdot \cdot (7)$
- 7 wherein the chroma C is calculated using a method defined
- 8 by the CIE 1997 Interim Color Appearance Model (Simple Version);
- 9 emitting light whose chromaticity is, on the CIE 1931
- 10 chromaticity diagram, in a range expressed by two equations (8)
- 11 and (9); and
- 12 emitting light whose visual clarity index is no smaller
- 13 than 110:
- $y \ge -2.63x^2 + 2.63x 0.263 \cdot \cdot \cdot (8)$
- 15  $y \ge -3.09x + 1.22 \cdot \cdot \cdot (9)$ .
- 1 39. The light source of Claim 38,
- wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light

- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- 6 wherein a ratio of a radiant energy Qv to a radiant
- 7 energy Qg satisfy an inequality (4) for a correlated color
- 8 temperature T[K]
- 9  $Qq/Qv \ge -0.11 \times 10^4 / T + 0.30 \cdot \cdot \cdot (4)$
- wherein the radiant energy Qv is in a wavelength of
- 11 380nm to 780nm and radiant energy Qg in a wavelength of 505nm
- 12 to 530nm.
- 1 40. The light source of Claim 39,
- 2 wherein the phosphor layer contains, as major components:
- a phosphor containing bivalent europium as an
- 4 emission center and having a peak emission at a wavelength range
- 5 of 440nm to 470nm;
- a phosphor containing bivalent manganese as an emission
- 7 center and having a peak emission at a wavelength range of 505nm
- 8 to 530nm;
- 9 a phosphor containing trivalent terbium as an emission
- 10 center and having a peak emission at a wavelength range of 540nm
- 11 to 570nm; and
- 12 a phosphor containing trivalent europium as an emission
- 13 center and having a peak emission at a wavelength range of 600nm
- 14 to 620nm.

- 1 41. The light source of Claim 40,
- wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength
- 4 range of 440nm to 470nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}:Eu^{2+};$
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>:  $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub>(PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub>:Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained
- 10 in the phosphors.
- 1 42. The light source of Claim 40,
- wherein the phosphor containing the bivalent manganese
- 3 as an emission center and having a peak emission at a wavelength
- 4 range of 505nm to 530nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}: Eu^{2+}, Mn^{2+};$
- 6  $CeMgAl_{11}O_{19}:Mn^{2+};$
- 7 Ce (Mg, Zn)  $Al_{11}O_{19}:Mn^{2+}$ ;
- 8  $Zn_2SiO_4:Mn^{2+}$ ; and
- 9  $CeMgAl_{11}O_{19}: Tb^{3+}, Mn^{2+}$
- wherein compounds on the left side denote host crystals,
- 11 and ions on the right side are emission centers contained in
- 12 the phosphors.
- 1 43. The light source of Claim 40,

- wherein the phosphor containing the trivalent terbium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 540nm to 570nm is composed of at least one of:
- 5  $LaPO_4: Ce^{3+}, Tb^{3+};$  and
- 6  $CeMgAl_{11}O_{19}: Tb^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.
- 1 44. The light source of Claim 40,
- 2 wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3:Eu^{3+}$ ; and
- $Gd_2O_3: Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 45. The light source of Claim 39,
- 2 wherein the phosphor layer has, as major components:
- 3 a phosphor containing both bivalent europium and bivalent
- 4 manganese as emission centers and having emission peaks both
- 5 at a wavelength range of 440nm to 470nm and at 505nm to 530nm;
- a phosphor containing trivalent terbium as an emission

- 7 center and having an emission peak at a wavelength range
- 8 to 570nm; and
- 9 a phosphor containing trivalent europium as an emis
- 10 center and having an emission peak at a wavelength range of 600
- 11 to 620nm.
- 1 46. The light source of Claim 45,
- wherein the phosphor containing the bivalent europium and
- 3 bivalent manganese as emission centers and having emission peaks
- 4 both at a wavelength range of 440nm to 470nm and at 505nm to
- 5 530nm is
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>: Eu<sup>2+</sup>, Mn<sup>2+</sup>
- 7 wherein a compound on the left side denotes a host crystal,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphor.
- 1 47. The light source of Claim 45,
- wherein the phosphor containing the trivalent terbium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 540nm to 570nm is composed of at least one of:
- 5 LaPO<sub>4</sub>: $Ce^{3+}$ ,  $Tb^{3+}$ ; and
- 6  $CeMgAl_{11}O_{19}:Tb^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphors.

- 1 48. The light source of Claim 45,
- wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3:Eu^{3+}$ ; and
- 6  $Gd_2O_3: Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 49. The light source of Claim 39,
- wherein the phosphor layer contains, as major
- 3 components:
- 4 a phosphor containing bivalent europium as an emission
- 5 center and having an emission peak at 440nm to 470nm;
- 6 a phosphor containing both trivalent terbium and bivalent
- 7 manganese as emission centers and having emission peaks both
- 8 at a wavelength range of 505nm to 530nm and at 540nm to 570nm;
- 9 and
- 10 a phosphor containing trivalent europium as an emission
- 11 center and having an emission peak at 600nm.
  - 1 50. The light source of Claim 49,
  - wherein the phosphor containing the bivalent europium as
  - 3 an emission center and having a peak emission at a wavelength

- 4 range of 440nm to 470nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}:Eu^{2+};$
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>:  $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub>:Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained in
- 10 the phosphors.
  - 1 51. The light source of Claim 49,
- wherein the phosphor containing the trivalent terbium
- 3 and the bivalent manganese as emission centers and having peak
- 4 emissions both at a wavelength range of 505nm to 530nm and at
- 5 540nm to 570nm is
- 6  $CeMgAl_{11}O_{19}: Tb^{3+}, Mn^{2+}$
- 7 wherein a compound on the left side denotes a host crystal,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphor.
- 1 52. The light source of Claim 49,
- 2 wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3: Eu^{3+}$ ; and
- 6 Gd<sub>2</sub>O<sub>3</sub>:Eu<sup>3+</sup>
- 7 wherein compounds on the left side denote host crystals,

- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 53. A light source, characterized by:
- 2 emitting light whose whiteness W is no smaller than 65 when the
- 3 light is reflected from a blank surface of a newspaper, the
- 4 whiteness W being calculated using chroma C of the light and
- 5 an equation (11),
- $W = -3.3C + 100 \cdot \cdot \cdot (11)$
- 7 wherein the chroma C is calculated using a method defined
- 8 by the CIE 1997 Interim Color Appearance Model (Simple Version);
- emitting light whose chromaticity is, on the CIE 1931
- 10 chromaticity diagram, in a range expressed by two equations (12)
- 11 and (13); and
- 12 emitting light whose visual clarity index is no smaller
- 13 than 115:

$$y \ge -2.63x^2 + 2.63x - 0.263 \cdot \cdot \cdot (12)$$

- $y \ge -3.09x + 1.22 \cdot \cdot \cdot (13).$
- 1 54. The light source of Claim 53,
- 2 wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light
- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- 6 wherein a ratio of a radiant energy Qv to a radiant

- 7 energy Qg satisfy an inequality (14) for a correlated color
- 8 temperature T[K]
- 9  $Qg/Qv \ge -0.11 \times 10^4/T + 0.30 \cdot \cdot \cdot (14)$
- wherein the radiant energy Qv is in a wavelength of
- 380nm to 780nm and radiant energy Qg in a wavelength of 505nm
- 12 \ to 530nm.
  - 1 55. The light source of Claim 54,
  - wherein the phosphor layer contains, as major components:
  - a phosphor containing bivalent Europium as an
  - 4 emission center and having a peak emission at a wavelength range
  - 5 of 440nm to 470nm;
  - a phosphor containing bivalent manganese as an emission
  - 7 center and having a peak emission at a wavelength range of 505nm
  - 8 to 530nm;
- 9 a phosphor containing trivalent terbium as an emission
- 10 center and having a peak emission at a wavelength range of 540nm
- 11 to 570nm; and
- 12 a phosphor containing trivalent europium as an emission
- 13 center and having a peak emission at a wavelength range of
- 14 600nm to 620nm.
- 1 56. The light source of Claim 55,
- wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength

- 4 range of 440nm to 470nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}: Eu^{2+};$
- 6 BaMgAl<sub>10</sub>O<sub>17</sub>:  $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub>: Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained
- 10 in the phosphors.
- 1 57. The light source of Claim 55,
- wherein the phosphor containing the bivalent manganese
- 3 as an emission center and having a peak emission at a wavelength
- 4 range of 505nm to 530nm is composed of at least one of:
- 5  $BaMgAl_{10}O_{17}: Eu^{2+}, Mn^{2+};$
- 6  $CeMgAl_{11}O_{19}:Mn^{2+};$
- 7 Ce (Mg, Zn)  $Al_{11}O_{19}:Mn^{2+}$ ;
- 8  $Zn_2SiO_4:Mn^{2+}$ ; and
- 9  $CeMqAl_{11}O_{19}: Tb^{3+}, Mn^{2+}$
- wherein compounds on the left side denote host crystals,
- 11 and ions on the right side are emission centers contained in
- 12 the phosphors.
  - 1 58. The light source of Claim 55,
  - wherein the phosphor containing the trivalent terbium
  - 3 as an emission center and having an emission peak at a wavelength.
  - 4 range of 540nm to 570nm is composed of at least one of:

- 5 LaPO<sub>4</sub>:  $Ce^{3+}$ ,  $Tb^{3+}$ ; and
- 6  $CeMgAl_{11}O_{19}:Tb^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 59. The light source of Claim 55,
- wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3: Eu^{3+}$ ; and
- 6  $Gd_2O_3: Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 60. The light source of Claim 54,
- wherein the phosphor layer has, as major components:
- 3 a phosphor containing both bivalent europium and bivalent
- 4 manganese as emission centers and having emission peaks both
- 5 at a wavelength range of 440nm to 470nm and at 505nm to 530nm;
- a phosphor containing trivalent terbium as an emission
- 7 center and having an emission peak at a wavelength range of 540nm
- 8 to 570nm; and
- 9 a phosphor containing trivalent europium as an emission

- 10 center and having an emission peak at a wavelength range of
- 11 600nm to 620nm.
  - 1 61. The light source of Claim 60,
- wherein the phosphor containing the bivalent europium and
- 3 bivalent manganese as emission centers and having emission peaks
- 4 both at a wavelength range of 440nm to 470nm and at 505nm to
- 5 530nm is
- 6 BaMqAl<sub>10</sub>O<sub>17</sub>: Eu<sup>2+</sup>, Mn<sup>2+</sup>
- 7 wherein a compound on the left side denotes a host crystal,
- 8 and ions on the right side are emission centers contained in
- 9 the phosphor.
- 1 62. The light source of Claim 60,
- wherein the phosphor containing the trivalent terbium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 540nm to 570nm is composed of at least one of:
- 5 LaPO<sub>4</sub>:  $Ce^{3+}$ ,  $Tb^{3+}$ ; and
- 6  $CeMgAl_{11}O_{19}:Tb^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 63. The light source of Claim 60,
- wherein the phosphor containing the trivalent europium

- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3:Eu^{3+}$ ; and
- 6 Gd<sub>2</sub>O<sub>3</sub>: Eu<sup>3+</sup>
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.
- 1 64. The light source of Claim 54,
- wherein the phosphor layer contains, as major
- 3 components:
- a phosphor containing bivalent europium as an emission
- 5 center and having an emission peak at 440nm to 470nm;
- 6 a phosphor containing both trivalent terbium and bivalent
- 7 manganese as emission centers and having emission peaks both
- 8 at a wavelength range of 505nm to 530nm and at 540nm to 570nm;
- 9 and
- 10 a phosphor containing trivalent europium as an emission
- 11 center and having an emission peak at 600nm.
  - 1 65. The light source of Claim 64,
  - 2 wherein the phosphor containing the bivalent europium as
- 3 an emission center and having a peak emission at a wavelength
- 4 range of 440nm to 470nm is composed of at least one of:
- 5  $BaMqAl_{10}O_{17}: Eu^{2+};$

- 6 BaMgAl<sub>10</sub>O<sub>17</sub>:  $Eu^{2+}$ ,  $Mn^{2+}$ ; and
- 7 (Ba, Ca, Sr, Mg)<sub>10</sub> (PO<sub>4</sub>)<sub>6</sub>Cl<sub>2</sub>:Eu<sup>2+</sup>
- 8 wherein compounds on the left side denote host crystals,
- 9 and ions on the right side are emission centers contained in
- 10 the phosphors.
  - 1 66. The light source of Claim 64,
- wherein the phosphor containing the trivalent terbium
- 3 and the bivalent manganese as emission centers and having peak
- 4 emissions both at a wavelength range of 505nm to 530nm and at
- 5 540nm to 570nm is
- 6  $CeMgAl_{11}O_{19}: Tb^{3+}, Mn^{2+}$
- 7 wherein a compound on the left side denotes a host crystal,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphor.
- 1 67. The light source of Claim 64,
- wherein the phosphor containing the trivalent europium
- 3 as an emission center and having an emission peak at a wavelength
- 4 range of 600nm to 620nm is composed of at least one of:
- 5  $Y_2O_3: Eu^{3+}$ ; and
- 6  $Gd_2O_3:Eu^{3+}$
- 7 wherein compounds on the left side denote host crystals,
- 8 and ions on the right side are emission centers contained
- 9 in the phosphors.

- 1 68. A luminaire, being characterized by:
- 2 emitting light whose whiteness is no smaller
- 3 than 85 and whose visual clarity index is no smaller than 110,
- 4 the whiteness W being calculated using chroma C of the light
- 5 and an equation (15),
- $W = -5.3C + 100 \cdot \cdot \cdot (15)$
- 7 wherein the chroma C is calculated using a method
- 8 defined by the CIE 1997 Interim Color Appearance
- 9 Model(Simple Version)
- 1 69. The luminaire of Claim 68,
- 2 wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light
- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- 6 wherein a ratio of a radiant energy Qv to a radiant
- 7 energy Qg satisfies an inequality (16) for a correlated color
- 8 temperature T[K]
- 9  $Oq/Ov \ge -0.11 \times 10^4 / T + 0.30 \cdot \cdot \cdot (16)$
- wherein the radiant energy Qv is in a wavelength of
- 11 380nm to 780nm and radiant energy Qg in a wavelength
- of 505nm to 530nm.
  - 1 70. The luminaire of Claim 68,
- wherein the light from the light source is adjusted

- 3 to a specified spectrum after passing through the translucent
- 4 cover.
- 1 71. The luminaire of Claim 68,
- wherein the light from the light source is adjusted to
- 3 a specified spectrum after reflected from the reflector.
- 1 72. A luminaire, being characterized by:
- 2 emitting light whose whiteness W is no smaller than 85,
- 3 and whose visual clarity index is no smaller than 115, the
- 4 whiteness W being calculated using chroma C of the light and
- 5 an equation(17)
- $W = -5.3C + 100 \cdot \cdot \cdot (17)$
- 7 wherein the chroma C is calculated using a method defined
- 8 by the CIE 1997 Interim Color Appearance Model (Simple Version).
- 1 73. The luminaire of Claim 72,
- wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light
- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- 6 wherein a ratio of a radiant energy Qv to a radiant
- 7 energy Qg satisfies an inequality (18) for a correlated color
- 8 temperature T[K]

- 9  $Qg/Qv \ge -0.11 \times 10^4/T + 0.30 \cdot \cdot \cdot (18)$
- wherein the radiant energy Qv is in a wavelength of
- 11 380nm to 780nm and radiant energy Qg in a wavelength
- of 505nm to 530nm.
  - 1 74. The luminaire of Claim 72,
  - wherein the light from the light source is adjusted
- 3 to a specified spectrum after passing through the translucent
- 4 cover.
- 1 75. The luminaire of Claim 72,
- wherein the light from the light source is adjusted to
- a specified spectrum after reflected from the reflector.
- 1 76. A luminaire, being characterized by:
- emitting light whose whiteness is no smaller than 65
- 3 obtained when the light is reflected from a blank surface of
- 4 a newspaper, the whiteness being calculated using chroma C of
- 5 the light and an equation (19),
- $W = -3.3C + 100 \cdot \cdot \cdot (19)$
- 7 wherein the chroma C is calculated using a method defined
- 8 by the CIE 1997 Interim Color Appearance Model (Simple Version);
- 9 emitting light whose chromaticity is, on the CIE 1931
- 10 chromaticity diagram, in a range expressed by two equations (20)
- 11 and (21); and

- 12 emitting light whose visual clarity index is no smaller
- 13 than 110:

$$y \ge -2.63x^2 + 2.63x - 0.263 \cdot \cdot \cdot (20)$$

15 
$$y \ge 3.09x + 1.22 \cdot \cdot \cdot (21)$$
.

- 1 77. The luminaire of Claim 76,
- wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light
- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- 6 wherein a ratio of a radiant energy Qv to a radiant
- 7 energy Qg satisfy an inequality (22) for a correlated color
- 8 temperature T[K]

9 
$$Qq/Qv \ge -0.11 \times 10^4/T + 0.30 \cdot \cdot \cdot (22)$$

- wherein the radiant energy Qv is in a wavelength of
- 11 380nm to 780nm and radiant energy Qq in a wavelength of 505nm
- 12 to 530nm.
  - 1 78. The luminaire of Claim 76,
  - wherein the light from the light source is adjusted
  - 3 to a specified spectrum after passing through the translucent
  - 4 cover.
  - 1 79. The luminaire of Claim 76,
  - wherein the light from the light source is adjusted to

- 3 a specified spectrum after reflected from the reflector.
- 1 80. A luminaire, being characterized by:
- 2 emitting light whose whiteness W is no smaller than 65 when the
- 3 light is reflected from a blank surface of a newspaper, the
- 4 whiteness W being calculated using chroma C of the light and
- 5 an equation (23),
- $W = -3.3C + 100 \cdot \cdot \cdot (23)$
- 7 wherein the chroma C is calculated using a method defined
- 8 by the CIE 1997 Interim Color Appearance Model (Simple Version);
- 9 emitting light whose chromaticity is, on the CIE 1931
- 10 chromaticity diagram, in a range expressed by two equations (24)
- 11 and (25); and
- 12 emitting light whose visual clarity index is no smaller
- 13 than 115:
- $y \ge -2.63x^2 + 2.63x 0.263 \cdot \cdot \cdot (24)$
- 15  $y \ge -3.09x + 1.22 \cdot \cdot \cdot (25)$ .
  - 1 81. The luminaire of Claim 80,
- wherein the light source is a fluorescent lamp
- 3 containing a phosphor layer, the light source emitting light
- 4 whose peak emissions are in four wavelength ranges of 440nm to
- 5 470nm, 505nm to 530nm, 540nm to 570nm, and 600nm to 620nm; and
- 6 wherein a ratio of a radiant energy Qv to a radiant
- 7 energy Qg satisfy an inequality (26) for a correlated color

- 8 temperature T[K]
- 9  $Qg/Qv \ge -0.11 \times 10^4/T + 0.30 \cdot \cdot \cdot (26)$
- wherein the radiant energy Qv is in a wavelength of
- 380nm to 780nm and radiant energy Qg in a wavelength of 505nm
- 12 to 530nm.
  - 1 82. The luminaire of Claim 80,
  - wherein the light from the light source is adjusted
  - 3 to a specified spectrum after passing through the translucent
- 4 cover.
- 1 83. The luminaire of Claim 80,
- wherein the light from the light source is adjusted to
- a specified spectrum after reflected from the reflector.